

Dissolution macro/micro/nano particle arguments by Rick Dill

OK, 40 years ago, I did some work on dissolution. It clearly should be somewhat related to the macro/micro/nano particle arguments here. I was working with organic compounds and came up with the techniques still used to define nanos-structures with dimensions like 22 nm.

For materials with a simple dissolution in a water based environment, I looked at a dissolution rate (rate at which the exposed surface was dissolved) that was controlled by the material constants (a variable defined by other processes) in terms of a removal rate in nanometers per second .. or perhaps even as low as per year.

This applies to chemical environments where either the liquid (water with various contents and dissolved ionic materials plus temperature were the key variables) or the surface being etched was the environment. It would appear to be relevant to cinnabar as well. Thus, under similar water conditions and temperature, the nanoparticles would have much more surface area compared to microparticles. If we truly believe the micro/nano comparison, the difference would be on the order 1,000,000, but most people's nano particles aren't 1000 times smaller than the micro ones.

A big potato of cinnabar fully exposed in a running stream would have incredibly smaller percentage dissolution. Of course there are some other variables, but these are the BIG ones.

The bottom line is that the articles quoted did not deal with the surface area question very well. There are also some higher level questions about dissolution of crystalline materials. The dissolution rate there is often very specific to crystal structure and to imperfections within the crystal. I spent some years thinking about that at various points. I won't try to lay that on the general view I've presented.

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So, let's look at possible sources of mercury sulfide. The dumps from the mines, no matter how many times worked over will have MACRO particles of cinnabar like the one Mike Boulland picked up on a hike after the rain and gave to me. Given the very low surface dissolution rate, this will probably mostly be around when the sun blows up in a million years. The source of nanoparticles is largely from atmospheric deposition into waters where there is a high sulfur content. Think of smelly swamps like the Okefenokee, where Pogo lives. It is subject to only atmospheric mercury, but has lots of smelly sulfur to combine with the incoming mercury. That makes it a hot spot for methyl mercury!

There were lots of deposition of atmospheric mercury locally, particularly in the early days. This will put nanoparticles in the soil which will be washed to the bay. That put mercury nano's downwind from New Almaden on/in the soil. It is undoubtedly still washing to the bay.

The calcines will be only sulfided if they have been in a rotten enough environment to displace the mercury oxide. Otherwise they will have either little particles (probably micro) of mercury or be oxide at again the micro level. There is a strong difference in the bonding of the oxide and sulfide and the solubility of the two. It seems that the bacteria might be able to handle the oxide better than the sulfide, but I can't comment on that.

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It seems that much of the drive for clean-up of New Almaden (known to others as "The Spicket") comes from Bay Keepers, who think that they can get the mercury content of the bay (with mercury coming from the local hills and some coming back from the Sierra) down to the level of the Pacific Ocean. They have a loud voice, but little sense in what they are trying to achieve. New Almaden is not a toxic waste dump of highly bio-active substances.

The FISH story is a good one. It ought to give people at least the FDA picture on eating fish with mercury. After all, we are NOT shutting down the sushi restaurants. We had a BIG fuss about mercury in canned tuna years ago, but it turned out that the tuna that are canned are low mercury .. not so for sushi! We do have recent reports of mercury poisoning in CA. That turns out to be unlicensed skin lightening mercury compounds used by some Asians and Hispanics. It is not from New Almaden or any of the mercury hot spots.

By the way, are you still eating rice? Have you followed the arsenic in rice story?

Rick

If mercury, asbestos, lead, and atmospheric pollution were anything like the panic of today, many of us living in New Almaden simply would not be alive. I played with mercury as a kid, given a bottle of dirty mercury by my dentist. I worked for a summer in an undergraduate college lab where a few of the faculty couldn't be in for long because of the "shakes". They had worked with mercury diffusion pumps and a lot of exposure to hot mercury (and its vapor). Every time a car used its brakes, fine asbestos particles would be emitted into the air. Don't ask me about how many times I cut asbestos boards. The current measure of chronic lead poisoning is that it falls off as the square of the distance from heavily trafficked highways of the 1960's. Trust me, I was in the near-in zone.

Incredible progress has been made. The last time I saw brown smog was not in Pittsburgh, but 30 years ago in Luxemburg. We no longer have lead in gasoline, although it is still used in propeller driven airplanes, but that is very low level and well dispersed. Lead is out of paint. Mercury chloride is no longer used to make hats, but that is very OLD news.

On the other hand, there are some very specific new items. If you use genetics to make soybeans kill insects, will these organic insecticides get to you? This isn't a hit at all genetic modifications, but rather an alert about where we might be looking.

..... perhaps more to come on ions and what they are!